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ABSTRACT

This study was conducted to examine differences and similarities between the views of teachers, principals and college professors as reflected on the Mathematics Inventory for Teachers (MIT) which is concerned with both cognitive and affective outcomes of mathematics instruction. A randomly selected group of secondary school principals and mathematics teachers, and a stratified random sample of university mathematics educators were administered the MIT. Factor analysis, multivariate and univariate analyses of variance were used to analyze collected data. Results show that principals and teachers tended to be more closely aligned and expressed a greater amount of ideological agreement than did teachers and university mathematics educators, at least with respect to their pattern of responses to the MIT items. This study suggests that secondary school teachers may be more content with the existing behavioral orientation in the mathematics classroom that had been heretofore expected. (HM)

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RESEARCH PAPER #19

Differences Between Teachers' Self-Ratings and Principal and University Faculty's Idealized Mathematics Teacher as Measured by a Mathematics Inventory

Thomas R. Post, William H. Ward, Jr.,
and Victor L. Willson
University of Minnesota

October 1975

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Overview

This study was conducted to examine differences and similarities between teachers', principals', and college professors' views as reflected on an inventory concerned with both cognitive and affective outcomes of mathematics instruction. Scores were compared using multivariate analysis of variance procedures.

Sampling Procedures

Teachers and Principals

The Minnesota Research and Evaluation Project was funded to study the process of educational change and evaluate a number of NSF-supported projects in selected regions of the country. As part of its total effort, in 1972, 222 secondary level principals in California, Michigan, and Indiana were randomly selected to participate in a data gathering procedure. Each principal was asked to randomly select one teacher from the mathematics faculty of their school. Both teachers and prinicpals subsequently completed a battery of instruments, among these the 30-item Mathematics Inventory for Teachers (MIT). Complete MIT data was ultimately available from 160 principals and 199 teachers (Bracht, 1972). The MIT (see Appendix A) contains statements concerning educational ideas and practices specifically dealing with the teaching and learning of mathematics in the secondary school.

The items assess attitudes toward mathematics and its teaching. It purports to let the respondents "express their beliefs and opinions". Each item is followed by the numerals 1 through 4 which correspond to: strongly agree, agree, disagree, and strongly disagree, respectively. Each respondent was asked to circle the numeral which most closely corresponds to her/his reaction to the item statement. Principals were asked to respond to the MIT as they believed an ideal mathematics teacher would, while the randomly selected teachers were asked to express their own beliefs and opinions. A total of 148 teacher-principal pairs responded to this instrument.

A previous paper (Post, Ward and Willson, 1974) discusses and contrasts these teacher-principal MIT scores, analysis being performed on subscales generated using factor analytic techniques.

University Level Mathematics Educators

University level participants in this study were selected from the mailing list of the Bulletin for Leaders from the National Council of Teachers of Mathematics. Forty-eight states (Alaska and Hawaii excluded) were stratified into six geographic regions. Participants names were randomly selected from each region.

The geographic regions and the number of participants (in parentheses) selected from within those regions are as follows: Far West (50), West (25), West Central (25), Central (50), South East (25), and North East (25). The Far West and Central States were proportionally oversampled because existing teacher and principal data were gathered exclusively from those two regions and oversampling was therefore throught to be desirable.

Only those persons having a college or university mailing address and currently involved with pre- and/or in-service teacher education were included in this study. Of the 200 names originally sampled, a total of 141 responses

were obtained. A second mailing to non-respondents was not pursued since a 71% return on survey questionnaires of this type was considered adequate; that is, the returned forms provided an accurate model of the characteristics of mathematics educators in general. Twenty-four persons returned incomplete MIT data sheets and were eliminated from the statistical analysis involving MIT results. These persons were, however, included in the descriptive reporting section of this report. Comparative results herein then were predicated upon the 117 college and university mathematics educators who completed all MIT items or upon a proper subset of these 117 educators.

University level participants were asked to respond to the MIT "as you would expect an ideal mathematics teacher to answer the items", the same directions as were given principals.

Demographic Information

In addition to the MIT (see Appendix A) a Participant Data Sheet (see Appendix B) eliciting various descriptive information was completed by each respondent. Table 1 enumerates the characteristics of the college and university level mathematics educators sampled in this study.

TABLE 1

Professional Background of University and College Level Mathematics Educators (N=141)

	B.A.	M.A.	Doctorate Ph.D. or Ed.D.
1. Highest Degree Earned: Number (Percent)	15 (11%)	17 (12%)	109 (77%) < Ph.D. 71 (50%) Ed.D. 38 (27%)
2. Degree Major:			
Mathematics	82 (58%)	63 (45%)	16 (11%)
Mathematics Education	20 (14%)	29 (21%)	54 (38%)
Miscellaneous*	16 (12%)	28 (19%)	32 (23%)
Missing Data	23 (16%)	21 (15%)	39 (28%)
	141 100%	141 100%	141 100%

	Mean	S.D.
3. Number of years teaching mathematics	12.4	8.1
Number of years teaching mathematics education	10.8	7.0

*Includes elementary and secondary education, curriculum and instruction, higher education, and administration.

As can be seen from Table 1, the vast majority (77%) of university and college mathematics educators sampled have earned doctorates. Slightly over one third of those sampled (38%) have a major in the field of mathematics education, 11% indicating a doctoral level major in mathematics, and another 23% majoring in elementary, secondary, curriculum and instruction, higher education, administration, and miscellaneous areas. It is conceivable that a significant portion of this latter group have, in fact, had major emphasis in mathematics education during their advanced graduate work, but that the degree earned was not labeled as such. It is conservatively estimated that more than half ($N > 71$) of the total sample have doctoral level major in mathematics education, and that as many as three/fourths of those who have an earned doctorate have actually majored in mathematics education.

TABLE 2

Professional Responsibilities of College and University Mathematics Educators (N=141)

Areas of Teaching Responsibility:	Number of Respondents
Mathematics	94 (67%)
Mathematics Methods - Elementary	67 (48%)
Mathematics Methods - Secondary	58 (41%)
Mathematics Methods - Both Elementary & Secondary	26 (18%)
Mathematics Methods - Secondary only	32 (23%)
Mathematics Methods - Elementary only	41 (29%)
Other Mathematics Education Courses	68 (48%)
Courses Other Than Mathematics Education	42 (30%)
Percentage of time devoted to mathematics education	$\bar{X}$=42% S.D.=33%

Table 2 details areas of teaching responsibility. An average of 42% of total time was spent directly with mathematics education activities. The rather large standard deviation indicates that much variability exists within this distribution. (Range 0 to 100). Apparently, there exists wide variation in the nature of the professional tasks mathematics educators are asked (expected) to perform.

The final question on the Participant Data Sheet asked respondents to categorize themselves philosophically and/or psychologically as chiefly "behaviorist", "cognitive", or "other".

Statistical Analyses

In a previous study, /Post, Ward, and Willson (1974) used factor analytic techniques to sort the 30 MIT items into eight factors and calculate factor scores for both principal and teacher in 148 randomly selected cases (principal-teacher pairs) (P-T). The vectors of principal-teacher factor score differences ($\overrightarrow{P-T}$'s) on seven identifiable factors* were tested via multivariate analysis of variance procedures against the hypothesis of no differences between a principal and his teacher (H_o: $\overrightarrow{P-T}=\vec{0}$). A multivariate F sufficient to reject this hypothesis at the .01 level lead to consideration of the univariate comparisons on each factor. Here the principal-teacher difference on two factors, "Teacher Concern for Student" and "Higher Order Concern" were different from 0 at $P < .01$ and .07 respectively. The weightings used in determining factor scores were derived from the factor analysis of teacher's responses only. A totally independent factoring of principal's responses, however, yielded an essentially identical factor structure. This noteworthy

*These factors were labeled: (1)Flexibility, (2) Mathematics as Process, (3) Teacher Concern for Student, (4) Vocational Satisfaction, (5) Non-Rigid Practices, (6) Attitude Toward Teaching, and (7) Higher Order Concerns.[Factor 8 was not discernible.]

stability would indicate that principals and teachers conceptualize the issues implied by the MIT in fundamentally the same manner.

It was originally anticipated that a parallel analysis would be performed in the present study. However, when factor analysis was performed on the MIT item data generated by college and university mathematics educators, difficulties arose. The resulting factor structure was seemingly unidentifiable and did not at all correspond to the structure generated in the earlier study. Such differences imply that college and university mathematics educators do not conceptualize mathematics education issues (at least those identified as factors in the earlier study) in the same manner as school personnel and raise the possibility that these groups are fundamentally different, each ascribing to ideas, procedures, and beliefs which are not only diverse but, also, perhaps misunderstood to one another. If substantiated by further research, these differences would inhibit the rapidity with which educational innovations are implemented in the school setting and would further help to explain why many of the types of methodological and ideological changes normally suggested by university level mathematics educators are not realized at the classroom level.

A post-hoc decision to contrast scores of the three groups at the item level was made following the discovery of large scale heterophily.* Significant differences on a large percentage of the MIT items would further confirm speculation of the existence of this phenomenon.

The question was raised as to whether university level elementary and secondary mathematics course instructors differed in their responses to the MIT in the multivariate sense. If so, specific areas of discrepancy would be

*A term meaning "ingrained differences between individuals or groups of individuals" used by Rogers and Shoemaker (1971) and Robert Reineke and Wayne Welch (1973).

pinpointed using univariate F procedures. Two such analyses were performed: (1) Contrasting those persons who identified themselves as elementary methods only and secondary methods only, and (2) Contrasting those persons who identified themselves as solely elementary methods instructors and those who indicated responsibility for both elementary and secondary methods courses. In each case, a 30 dependent variable multivariate analysis of variance was conducted.

In analysis (1) (Elementary methods only contrasted with secondary methods only) the F-ratio for the multivariate test of equality of mean vectors (30 dependent variables = individual MIT items), = 1.20, df =(30, 35), $P < .30$.

In analysis (2) (Elementary methods only, contrasted with elementary and secondary methods) the F-ratio for the multivariate test of equality of mean vectors (30 dependent variables = individual MIT items) = 1.12, df = (30, 56), $P < .35$.

It was concluded from these two multivariate analyses that both elementary and secondary methods persons responded to the MIT in essentially the same manner. It is therefore reasonable to combine data from elementary and secondary level methods persons in subsequent contrasts with principals and/or teachers to increase the power of the analysis.

In contemplating the contrasts of university educators to teachers to principals, a potentially major design problem arose. The university educators were obviously an independent group; however, it was equally obvious that most teachers and principals in the data occurred as matched pairs. The problem could be circumvented if the principals and teachers could be treated <u>as if</u> they were independent samples, a treatment justified if the groups could be shown to be approximately statistically independent.

The likelihood of such independence was investigated in two ways. Directly, the correlations of principal-teacher responses for the 30 items were considered for the 148 complete principal-teacher pairs in the data. The distribution did obviously favor correlations greater than zero; however, most values were quite small. Only five items had $|r|>.18$ and a Kolmogorov-Smirnov test failed to reject the hypothesis that the obtained r's represented a random sample from a normal distribution with a mean of 0 at $\alpha = .01$. Indirectly, potential principal-teacher differences on an item by item basis were investigated by considering the two hypotheses H_0: $\overrightarrow{P-T} = \vec{0}$ (1) = (the hypothesis appropriate for dependent or independent groups) and H_0': $\vec{P}-\vec{T} = \vec{0}$ (2) = (the hypothesis appropriate for independent groups only). The results of the multivariate and attendant univariate tests of these hypotneses would tend to converge as the condition of independence of a building's principal and teacher were more nearly met. Results with the current data appear highly similar. Details of these investigations may be found in Appendix C.

On the basis of the above evidence, it was concluded that such statistical dependence as did exist was slight and that treating the principals and teachers as independent groups was justified.

In all, complete MIT data was available from 160 principals, 199 teachers and 117 college and university level mathematics educators. Summary statistics for each group by item are given in Appendix A and Table 4. Multivariate and concurrent univariate analyses of variance (Finn, 1974) were performed on the overall hypothesis of no group effect, and for each pairwise contrast between groups.

TABLE 3

Multivariate Tests of Equality of Mean Vectors
[30 Dependent Variables are MIT Items]

	Contrast	Multivariate F	df	P Less than
1.	Overall (P-T-U)*	5.82	60,888	.01
2.	Pairwise			
	a) U-T*	6.56	30,444	.01
	b) P-T*	3.69	30,444	.01
	c) P-U*	5.42	30,444	.01

Table 3 indicates that principals, teachers, and college and university methods course instructors have responded in a significantly different fashion to the questions and issues suggested by the MIT when these responses are considered in their entirety. Such differences imply that these three groups conceptualize the various parameters inherent in the teaching and learning of mathematics in a significantly different manner (both statistically and ideologically). Table 5 details group comparisons on individual MIT items.

When the information in Tables 4 and 5 are considered together, an interesting pattern appears. For each item, the three groups may be ordered based on their mean scores. On item one, for example, this ordering would be principals (2.20), teachers (2.39), university people (3.06); on item two, principals (1.46), teachers (1.47), university people (1.80), and so on. When those means which Table 5 indicates as not being significantly ($\alpha = .05$) different are thought of as ties, the fact stands out that for 28 of the 30

Tests are not orthogonal. P values are hypothesis-wise.
*P-T-U = Principals vs. Teachers vs. University Persons
U-T = University vs. Teachers
P-T = Principals vs. Teachers
P-U = Principals vs. University

TABLE 4

Summary Statistics - 30 MIT Items

ITEM	Principals (N=160)		Teachers (N=199)		University People (N=117)	
	$\bar{X}$	σ	$\bar{X}$	σ	$\bar{X}$	σ
1	2.20	.759	2.39	.736	3.06	.758
2	1.46	.603	1.47	.557	1.80	.576
3	2.78	.874	2.99	.693	3.16	.820
4	1.61	.551	1.45	.509	1.36	.533
5	1.44	.523	1.48	.521	1.37	.502
6	2.47	.824	2.42	.799	2.74	.767
7	3.20	.823	3.32	.617	3.32	.717
8	1.35	.478	1.38	.506	1.17	.378
9	2.85	.841	3.15	.709	3.46	.664
10	1.78	.603	1.65	.649	1.97	.835
11	1.49	.526	1.50	.521	1.24	.485
12	1.71	.610	1.76	.651	1.93	.679
13	1.75	.824	1.66	.683	1.51	.702
14	2.97	.914	3.21	.648	3.48	.624
15	2.73	.760	2.50	.797	2.84	.669
16	1.67	.601	1.77	.657	1.83	.660
17	2.52	.769	2.49	.744	2.97	.725
18	3.14	.740	3.18	.687	3.34	.645
19	1.74	.575	1.65	.649	1.50	.502
20	3.35	.787	3.42	.570	3.35	.606
21	2.05	.698	1.86	.659	1.52	.551
22	1.38	.500	1.40	.502	1.44	.532
23	2.56	.750	2.71	.729	2.78	.708
24	2.36	.628	2.41	.620	2.88	.697
25	2.89	.697	2.69	.768	2.91	.719
26	2.86	.687	3.01	.689	3.48	.551
27	2.99	.850	2.93	.841	3.21	.676
28	1.64	.532	1.60	.540	1.48	.551
29	2.45	.662	2.57	.622	2.69	.688
30	1.57	.589	1.87	.661	1.83	.620

TABLE 5

Pairwise Comparisons - 30 MIT Items

MIT Item NUMBER	Principals - Teachers		Principals - University People		Teachers - University People	
	$\lvert\bar{X}_P - \bar{X}_T\rvert$	Significant*	$\lvert\bar{X}_P - \bar{X}_U\rvert$	Significant*	$\lvert\bar{X}_T - \bar{X}_U\rvert$	Significant*
1	.19	x	.86	x	.67	x
2	.01		.34	x	.33	x
3	.21	x	.38	x	.17	
4	.16	x	.25	x	.09	
5	.04		.07		.11	
6	.05		.27	x	.32	x
7	.12		.12		.00	
8	.03		.18	x	.21	x
9	.30	x	.61	x	.31	x
10	.13		.19	x	.32	x
11	.01		.25	x	.26	x
12	.05		.22	x	.17	x
13	.09		.24	x	.15	
14	.24	x	.51	x	.27	x
15	.23	x	11		.34	x
16	.10		.16		.06	
17	.03		.45	x	.48	x
18	.04		.20	x	.16	x
19	.09		.24	x	.15	x
20	.07		.00		.07	
21	.19	x	.53	x	.34	x
22	.02		.06		.04	

(continued)

TABLE 5 (continued)

Pairwise Comparisons - 30 MIT Items

MIT Item NUMBER	Principals - Teachers		Principals - University People		Teachers - University People	
	$\lvert\bar{X}_P - \bar{X}_T\rvert$	Significant*	$\lvert\bar{X}_P - \bar{X}_U\rvert$	Significant*	$\lvert\bar{X}_T - \bar{X}_U\rvert$	Significant*
23	.15		.22	x	.07	
24	.05		.52	x	.47	x
25	.20	x	.02		.22	x
26	.15	x	.62	x	.47	x
27	.06		.22	x	.28	x
28	.04		.16	x	.12	
29	.12		.24	x	.12	
30	.30	x	.26	x	.04	

*Newman-Keuls procedure for multiple comparisons, $\alpha = .05$ for each item.

items the principals and university people are at opposite ends of the orderings, with teachers either tied with one or at a position of their own in the middle. Exceptions, the items where teachers occupy an extreme position, alone, are items 15 and 25. These items, along with items 5, 10, 20, and 30 which show the same pattern but not to the level of significance, make up one of the originally designed subscales of the instrument, a subscale designed to measure "attitude toward rating teacher concern for student". In all other dimensions tapped by the instrument, teachers appear to be found in a middle rather than extreme position. When university persons were contrasted with teachers, significant differences occurred on 18 of 30 MIT Items. When principals and teachers were contrasted, significant differences occurred on only 10 of 30 MIT Items. These data imply that principals and teachers tend to be more closely aligned and express a greater amount of ideological agreement than teachers and university mathematics educators, at least with respect to their patterns of responses to the MIT Items.

Discussion of Results

It was mentioned earlier that the Participant Data Sheet designed for college and university level persons contained an item which asked respondents to categorize themselves a "behaviorist", "cognitive", or "other", as these labels related to their principle orientation regarding the teaching and learning of mathematics. Realizing the pitfalls of such broadly conceived questions, the authors expected a good deal of criticism on this question in the space provided for comments. Most comments were expected to suggest that such a dichotomy is unrealistic since both the behaviorist and cognitive positions have a rightful place in a well balanced program. Of 136 persons who completed this question, 8 (6%) checked "behaviorist", 96 (71%) checked "cognitive", and 32 (24%) checked "other", 18 of these qualified

their response by suggesting the existence of an artificial and unrealistic forced choice and indicating that the first two in combination were probably optimal.

What might such a response from college and university teachers mean in terms of contrasting ideological positions of classrooms, teachers, and methods course instructors? We digress momentarily to elaborate on several of our predispositions regarding existing secondary level mathematics programs. The following comments tend to be speculative in nature and are not directly derived from the data gathered for this paper. The comments made are implied by the authors' professional experiences and are suggested here as one possible explanation for the large scale differences noted earlier.

A vast majority of secondary school mathematics programs seem to be behaviorally oriented. This assumption is derived in part by the observation that an overwhelming number of mathematics programs seem to be primarily determined by some textbook or standardized syllabus. Most textbooks tend to be largely concerned with the development and maintenance of the basic skills, which at the secondary level might be defined as techniques for the solution of single equations and systems of equations, manipulation of algebraic fractions, solutions of trigonometric identities or one of a large number of other skill oriented manipulations. Such skills are clearly necessary, but just as clearly (at least in the writers' minds) not sufficient. Often skill oriented textbooks lead to the development of limited behavioral objectives which can be interpreted or even misinterpreted as a behavioral approach to the learning of mathematics. An advantage of such a program, however, is the fact that precisely defined skills are most easily "behavioralized" than other higher level* outcomes such as application, synthesis, and evaluation.

*Higher level in the same sense used by Benjamin Bloom in his Taxonomy of Educational Objectives (1969).

School programs which revolve around a textbook can be considered to be behavioristically inclined, as can persons teaching in those programs.

Persons having a principally cognitive orientation, on the other hand, would tend to de-emphasize (not eliminate) the use of the textbook and in its place suggest a variety of other extra-text activities. It is strongly suspected that this (text de-emphasis) is a (the) principle "message" contained in a large percentage of the nation's college and university level mathematics methods courses. This suspicion is further supported by participant response to the item discussed above. There very well might exist an enormous population of "behaviorally oriented" mathematics teachers (and administrators) who are being instructed by a population of "cognitively oriented" mathematics methods instructors. If true, there would exist substantive ideological discrepancies between "message receivers" (the classroom teacher as a representative of the public educational system) "message senders" and (mathematics methods course instructors). We turn now to a discussion of observed differences between principals, teachers, and university level mathematics educators on the Mathematics Inventory for Teachers (MIT).

The relatively large scale discrepancies obtained (see Tables 3, 4, and 5) suggest inherent or learned differences between groups. The magnitude of differences decreases as one proceeds from overall group comparisons to university instructor-teacher comparisons, to principal-teacher comparisons. Teachers seem to be more ideologically compatible with their respective principals than with university level mathematics methods instructors. This is especially noteworthy since the MIT Scale was concerned exclusively with the teaching and learning of mathematics, and it is unlikely that a large portion of principals have been exposed recently to contemporary ideas regarding the teaching and learning of mathematics, at least as those ideas are espoused by university

level mathematics educators. Why would mathematics teachers be less inclined to relate ideologically to those ideas espoused by "experts" in the field of mathematics teaching than to those of their school principal, whose general lack of expertise in the field is both known and accepted? At least three possible non-competing explanations can be discussed. The first is well known and the second and third have been suspected for quite some time. If valid, all have serious implications for classroom practice: (1) By virtue of working within a larger organization, in this case the school, constraints are placed on an individual teacher's decision making power. This phenomenon tends to result in an apparent within-school conformity of thought and idea. (2) This study implies that contemporary programs in mathematics education at the college and university level have a decidely cognitive bend. In possible contrast are currently used objective based mathematics programs which appear to be more behaviorally oriented. It appears that the degree of transfer from formal professional education to actual classroom implementation may thus be minimal. Whether the ideas and practices espoused in formal mathematics courses are considered simply idealistic, non-functional, or impractical is not clear at this time, but what does seem to be evident is the existence of fundamental differences in the conceptual framework within which teachers, principals, and university level mathematics educators approach the teaching and learning of mathematics. (3) Since the popularity of cognitive oriented mathematics learning has occurred primarily within the last decade or so, it is conceivable that a large number of secondary mathematics teachers who have completed their formal professional education sequence prior to that time have chosen not to formally update their professional skills. Such persons, having been originally trained in the behavioral or neo-behavioral approaches, may not be at all familiar with the cognitive position, or after limited exposure may have rejected such an orientation. Many college level educators

have lamented the seemingly interminable amount of time required to introduce and sustain substantive curricular and pedagogical change within the educational system. We think such university and college educators continually assume that the message (plea for change to a more cognitive type orientation) is eminently worthwhile and therefore acceptable at least at the intellectual level by the classroom teacher. The authors realize that at this point such an assumption is not fully substantiated and that more detailed and relevent information must in the future be accumulated. Given such an assumption, however, and considering that change appears slow to occur, educators at the university and classroom levels often pinpoint other factors which are responsible for "lack of progress". Frequent examples being: parents, administration, tradition, standardized tests, and school organizational patterns, to mention a few. Given that teachers are more compatable ideologically with their principals than with college and university level mathematics educators, the present study suggests that secondary school teachers may be more content with the existing behavioral orientation in the mathematics classroom than had been heretofore expected.

This study is viewed as both preliminary and exploratory in nature. As noted earlier, several of the statements made are conjectural at this point in time. It should be noted, however, that these conjectures are not inconsistent with the data and are further supported by the authors' professional experiences.

Additional research is needed to shed more light on these important issues. New and more refined instruments need to be developed, written participant responses should be coupled with structured interviews, and various other populations and subject disciplines might also be examined. If large scale population differences persist and further evidence is found to be consistent with the data and speculation herein, a significant factor contributing to

the indolent pace with which innovation occurs in the educational system will have been identified. Such positive identification will undoubtedly prove useful in future attempts to develop a more systematic and comprehensive approach to the improvement of curricula and pedagogy in the nation's schools.

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APPENDIX A

Mathematics Inventory for Teachers

(MIT)

Item Means and Standard Deviations for Principals, Teachers, and University Mathematics Educators

IMPORTANT REMINDER TO COLLEGE AND UNIVERSITY LEVEL MATHEMATICS EDUCATORS PARTICIPATING IN THIS STUDY:

RESPOND AS YOU WOULD EXPECT AN IDEAL MATEMATICS TEACHER TO ANSWER THE ITEMS.

MATHEMATICS INVENTORY FOR TEACHERS (MIT)

Directions

This inventory contains statements on educational ideas and practices about which we all have opinions and attitudes. We all think differently about such matters, and this inventory is an attempt to let you express your beliefs and opinions.

Respond to each statement by circling one of the numbers to the right of the statement. The numbers should be interpreted as follows:

1: Strongly Agree (SA)	I agree strongly with this statement.
2: Agree (A)	I agree with this statement.
3: Disagree (D)	I disagree with this statement.
4: Strongly Disagree (SD)	I disagree strongly with this statement.

Respond honestly to each statement. We are interested in knowing how mathematics teachers really feel about certain ideas and what they actually do in certain situations.

Before beginning the inventory, please print your name on the line below.

_____

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Explanation: Group Means and Standard Deviations

(1) = Principals
(2) = Teachers
(3) = University Mathematics Educators

		MEANS	STANDARD DEVIATIONS
1.	The field of mathematics consists primarily of procedures and formulas which are used in many occupations and in everyday experiences.	(1) 2.20 (2) 2.39 (3) 3.06	(1) .76 (2) .74 (3) .76
2.	A good learning environment is maintained when instruction is focused on the interests and motivation of the students.	(1) 1.46 (2) 1.47 (3) 1.80	(1) .60 (2) .56 (3) .58
3.	There are many aspects of teaching mathematics which I do not enjoy.	(1) 2.76 (2) 2.99 (3) 3.16	(1) .90 (2) .89 (3) .82
4.	I show students different ways of solving the same mathematics problems.	(1) 1.61 (2) 1.45 (3) 1.36	(1) .55 (2) .51 (3) .53
5.	I frequently spend time helping students who have difficulty understanding mathematics.	(1) 1.44 (2) 1.48 (3) 1.37	(1) .52 (2) .52 (3) .50
6.	One of the most important reasons for studying mathematics is that it helps one to think according to strict rules and procedures.	(1) 2.49 (2) 2.42 (3) 2.74	(1) .81 (2) .80 (3) .77
7.	Nearly all class time should be spent by the teacher in explaining mathematical ideas, procedures, and formulas.	(1) 3.23 (2) 3.32 (3) 3.32	(1) .78 (2) .62 (3) .72
8.	I receive personal satisfaction from teaching mathematics.	(1) 1.35 (2) 1.38 (3) 1.17	(1) .48 (2) .51 (3) .38
9.	When working assignments, students are expected to follow the rules and procedures that I teach for solving problems even though there are other ways of solving the problems.	(1) 2.88 (2) 3.15 (3) 3.46	(1) .81 (2) .71 (3) .66
10.	I regularly (at least once a week) inform my students of the learning progress they are making by giving assignments, quizzes, or tests.	(1) 1.78 (2) 1.65 (3) 1.97	(1) .60 (2) .65 (3) .84
11.	In mathematics there is opportunity for developing and experimenting with different methods of solving problems.	(1) 1.49 (2) 1.50 (3) 1.24	(1) .53 (2) .52 (3) .49

		MEANS	STANDARD DEVIATIONS
12.	Student interest is greater if instruction is organized so that the logical sturcture of mathematics is apparent throughout the course.	(1) 1.71 (2) 1.76 (3) 1.93	(1) .61 (2) .65 (3) .68
13.	If I could start my career again, I would become a mathematics teacher.	(1) 1.75 (2) 1.66 (3) 1.51	(1) .82 (2) .68 (3) .70
14.	I am more impressed with assignments in which students are neat and careful in following a recommended procedure than with assignments which show the student has developed his own method for solving a problem.	(1) 2.97 (2) 3.21 (3) 3.48	(1) .91 (2) .65 (3) .62
15.	When I am not in class, I generally spend my school time alone or with other teachers.	(1) 2.73 (2) 2.50 (3) 2.84	(1) .76 (2) .80 (3) .67
16.	The field of mathematics will probably undergo some major changes in the next 25 years.	(1) 1.67 (2) 1.77 (3) 1.83	(1) .60 (2) .66 (3) .66
17.	Conduct rules provide the best method for establishing an optimum learning climate.	(1) 2.52 (2) 2.49 (3) 2.97	(1) .77 (2) .74 (3) .72
18.	Teaching mathematics is more work than enjoyment.	(1) 3.14 (2) 3.18 (3) 3.34	(1) .74 (2) .69 (3) .65
19.	I place more emphasis on the reasoning involved in solving problems than on the learning of rules and formulas.	(1) 1.74 (2) 1.65 (3) 1.50	(1) .57 (2) .65 (3) .50
20.	Students who are having problems in learning mathematics should get help primarily from their parents, a tutor, or other students rather than from the teacher.	(1) 3.35 (2) 3.42 (3) 3.35	(1) .79 (2) .57 (3) .61
21.	The field of mathematics consists more of ideas and principles than formulas and procedures.	(1) 2.05 (2) 1.86 (3) 1.52	(1) .70 (2) .66 (3) .55
22.	The teaching of mathematics is more successful if the teacher first develops positive attitudes in the students.	(1) 1.38 (2) 1.40 (3) 1.44	(1) .50 (2) .50 (3) .53
23.	There are several topics in my mathematics courses that I do not enjoy teaching.	(1) 2.56 (2) 2.71 (3) 2.78	(1) .75 (2) .73 (3) .71

		MEANS	STANDARD DEVIATIONS
24.	Most of the mathematics problems I assign are intended to give students practice in using a particular rule or formula.	(1) 2.36 (2) 2.41 (3) 2.88	(1) .63 (2) .62 (3) .70
25.	Students who are not making an effort to learn mathematics should not be required to take mathematics courses.	(1) 2.89 (2) 2.69 (3) 2.91	(1) .70 (2) .77 (3) .72
26.	The study of mathematics consists primarily in learning formulas and computational procedures.	(1) 2.86 (2) 3.01 (3) 3.48	(1) .69 (2) .69 (3) .55
27.	The outcomes of a mathematics course are maximized when the rate and depth of learning are about the same for all students.	(1) 2.99 (2) 2.93 (3) 3.21	(1) .85 (2) .84 (3) .68
28.	I like to discuss various aspects of teaching mathematics with other teachers.	(1) 1.64 (2) 1.60 (3) 1.48	(1) .53 (2) .54 (3) .55
29.	After I explain the basic concepts and principles, students are expected to develop the methods for solving problems.	(1) 2.45 (2) 2.57 (3) 2.69	(1) .66 (2) .62 (3) .69
30.	The teacher should take the initiative in helping students who have difficulty in learning mathematics rather than waiting for the students to ask for help.	(1) 1.57 (2) 1.87 (3) 1.83	(1) .59 (2) .66 (3) .62

APPENDIX B

Participant Data Sheet

Accompanying the

Mathematics Inventory for Teachers

(MIT)

College or University Level Participant Data Sheet

PLEASE NOTE: IF YOU ARE NOT CURRENTLY TEACHING PRE-SERVICE OR IN-SERVICE TEACHERS AND EMPLOYED AT A COLLEGE OR UNIVERSITY, WE HAVE MADE AN ERROR IN OUR PARTICIPANT SELECTION PROCEDURES. IN THAT EVENT, WOULD YOU SIMPLY COMPLETE THIS PARTICIPANT DATA SHEET AND RETURN ALL MATERIALS TO US. THANK YOU.

1. Name:

2. Institution:

3. Subject areas you teach: (please check)

   ( ) Mathematics (please list areas, i.e., Non-Euclidean Geometry)

   ( ) Mathematics Methods: _____Elementary _____Secondary

   ( ) Other Mathematics Education Courses (please list)

   ( ) Courses Other than Mathematics and Mathematics Education (please list)

4. Approximately what proportion of your instructional energies are devoted to the area of mathematics education? (Do not include mathematics teaching in this estimate.)

5. Degrees held:

	Major	Minor	Institution
( ) Baccalaureate			
( ) Masters			
( ) Ph.D. ( ) Ed.D.			

6. Number of years college or university level teaching experience in area of: Mathematics _____ Mathematics Education _____

7. Philosophically, do you perceive yourself subscribing principally to the Behaviorist (i.e., Skinner, Gagne, et.al.) or the Cognitive (i.e., Piaget, Bruner, et.al.) psychological position as these position pertain to the teaching and learning of mathematics?

   ( ) Behaviorist ( ) Cognitive ( ) Other_____

   Comment:

APPENDIX C

Kolmogorov-Smirnov Test

Alternative Models Test

Kolmogorov-Smirnov Test

Observed Principal-Teacher Response Correlations - Thirty Items

-.195	-.153	-.096	-.092	-.029	-.014	-.011	.005
.009	.018	.022	.032	.037	.038	.040	.046
.050	.056	.060	.101	.116	.126	.147	.151
.155	.179	.186	.187	.250	.333		

$n = 148$

H_o: Observed r's are a random sample from a population of r's

$\sim N (0 , n^{-\frac{1}{2}})$

Absolute value of maximum deviation = .258

Two-tailed P = .0373

Conclusion: Fail to reject H_o at $\alpha = .01$

Alternative Models Test

Model I $H_o: \overrightarrow{P - T} = \vec{0}$ Model II $H_o': \vec{P} - \vec{T} = \vec{0}$

Multivariate F = 3.24 P .001 (d.f. = 30,118)

Multivariate F = 3.45 P .001 (d.f. = 30,328)

Univariate Tests

	Model I (d.f. = 1,147)		Model II (d.f. = 1,357)	
Sig. at:	.01	.05	.01	.05
Item				
1		x		x
2				
3				x
4		x	x	x
5				
6				
7				
8				
9			x	x
10				
11				
12				
13				
14			x	x
15	x	x	x	x
16				
17				
18				
89				
20				
21	x	x	x	x
22				
23				
24				
25	x	x	x	x
26				x
27		x		
28				
29				
30	x	x	x	x

Except for the cases of Items 26 and 27, all discrepencies between results under the two models may be due to the larger df error under Model II.

Conclusion: Fail to reject the proposition that teachers' responses are independent of their principals' responses.